2313
+
BZ 7000

# Instruction Manual

## Graphics Recorder Type 2313
## plus Application Package BZ 7000

A high-resolution, dot-matrix printer offering fast hard-copy documentation of data transmitted by digital equipment furnished with an IEC/IEEE interface. As standard it includes an Application Package BZ 7000 which permits use as a conventional alphanumeric printer/graphics recorder, plus direct copying of measurements displayed by the B&K Dual Channel Signal Analyzers Types 2032 and 2034.

As extra a range of optional Application Packages may be fitted in place of BZ 7000. These convert the 2313 to suit the individual documentation needs of B&K frequency analyzing and measuring equipment, plus perform special tasks such as digital storage and reformatting of data. Besides allowing stored measurements to be outputted at a later date, new types of measurement may be generated. Thus whatever the analysis or measurement equipment used, the 2313 opens up whole new range of measurement possibilities and applications.

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FROM AREA

# GRAPHICS RECORDER TYPE 2313
# PLUS
# APPLICATION PACKAGE BZ 7000

From serial no. 973241

October 1983

# SAFETY CONSIDERATIONS

This apparatus has been designed and tested according to Class II of IEC Publication 348, Safety Requirements for Electronic Measuring Apparatus, and has been supplied in safe condition. The present Instruction Manual contains information and warnings which should be followed by the user to ensure safe operation and to retain the apparatus in safe condition. Special note should be made of the following:

**APPLICATION OF POWER**

Before each use of the apparatus, check that it is set to match the available mains voltage and that the correct fuse is installed.

**SAFETY SYMBOLS**

⚠ The apparatus will be marked with this symbol when it is important that the user refer to the associated warning statements given in the Instruction Manual.

⊥ Chassis terminal ⏚ Safety earth terminal ⚡ Hazardous voltage

**WARNINGS**

Whenever it is likely that the correct function or operating safety of the apparatus has been impaired, the apparatus must be made inoperative and be secured against unintended operation.

Any adjustment, maintenance and repair of the open apparatus must be avoided as far as possible and, if unavoidable, must be carried out only by trained service personnel.

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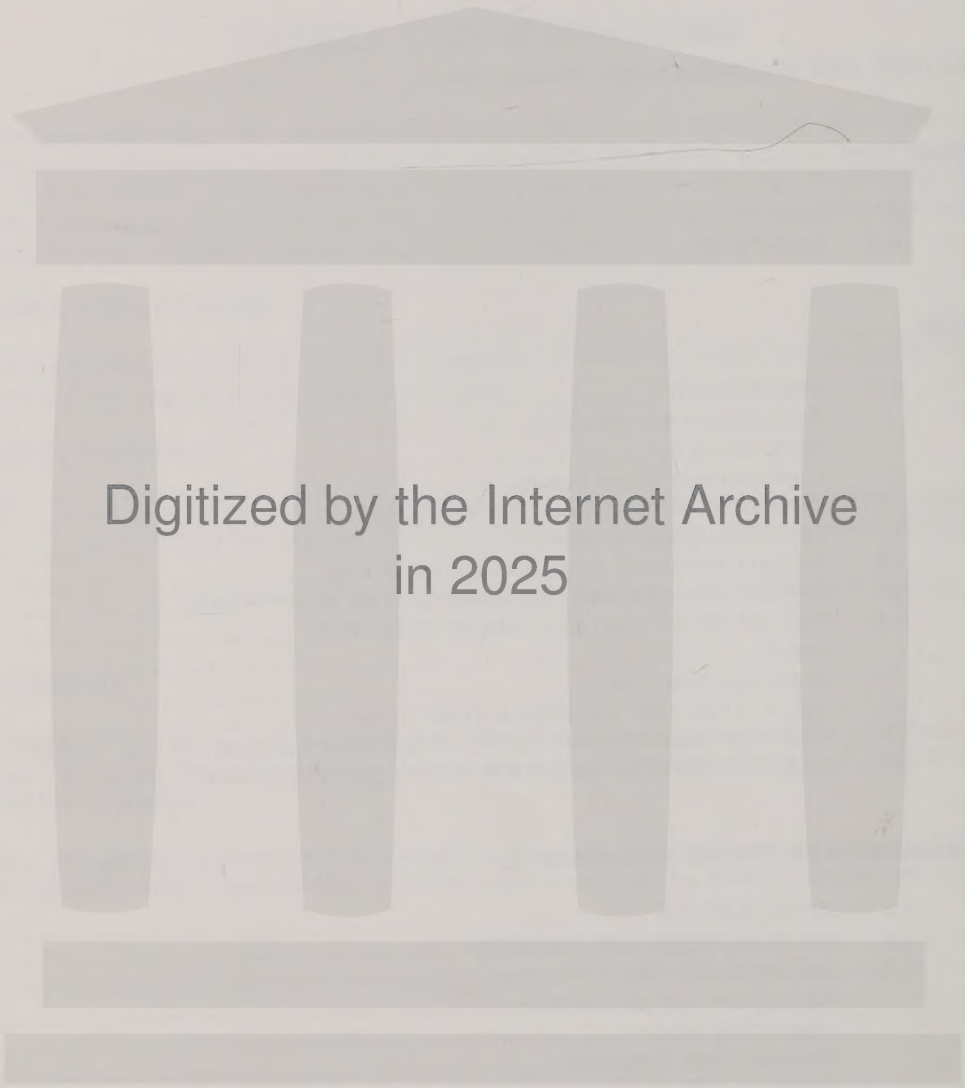
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# Graphics Recorder

USES:

- Dot-matrix printer for direct copying of measured spectra as presented on the display screen of digital measuring or analyzing equipment, as well as documentation of front panel control settings
- Versatile system controller for instruments equipped with IEC/IEEE digital interface bus
- Digital recorder for storage of spectra and front panel control setting data
- Reformatting of data for new types of measurement. Extends measurement capability of B&K equipment

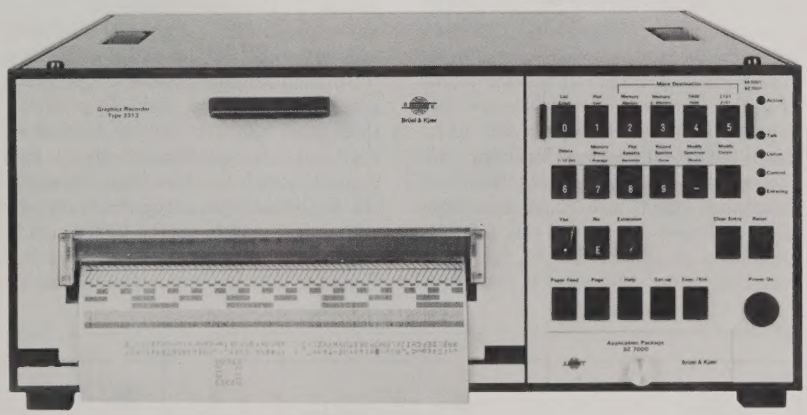
FEATURES:

- High-resolution graphic and alphanumeric print out using fixed 512 point print head with 0,2 mm step paper feed
- Accepts 210 mm wide rolls of metallized paper. One 50 m roll equivalent to 160 A4 charts
- 96 standard and 32 special alphanumeric characters according to ISO 646 and 2022 standards
- Range of plug-in Application Packages available to suit the individual documentation and measurement needs of B&K measuring and analyzing equipment
- Built-in crystal controlled clock for print out of date and time together with measurement results
- Continuous and volatile memories for storage of measurement spectra
- Choice of Operating Set-Ups for specifying type of print out, memory allocation and measurement functions
- Simple, easy to follow pushkey operation, plus extensive "Help" file for step by step guidance of first time users

## Introduction

The Graphics Recorder Type 2313 is a highly versatile alphanumeric printer and graphics plotter for use with digital measuring and analyzing equipment furnished with an IEC /IEEE interface bus. It offers fast, fully annotated, graphic plots of measured spectra and other data as presented on the display screen of B&K Digital Frequency Analyzers, plus documents measurement results and front panel control data transmitted by other equipment with matching interface.

Besides documentation of data, the 2313 is capable of performing a variety of other important tasks for which extra equipment would normally be required. Using its continuous and volatile memories, for example, several hundred complete measurement spectra can be recorded and stored for future print out or transmission to other equipment. Also, new types of measurement can be generated from stored and incoming data, plus use as a system controller is possible. Thus, whatever measuring instrumentation is employed, the 2313 opens up a whole new range of measurement possibilities and applications.



## Description

**Writing System**

The writing system of the 2313 accepts 210 mm wide rolls of electrosensitive paper QP 4690. Two 50 m rolls are supplied with the Recorder, each providing the equivalent of 160 A4 (metric) size charts. The paper is of the readily available metallized type and produces clear well defined print that is not susceptible to fading as with chemically treated types.

When loaded in the 2313, the metallized surface of the paper contacts a fixed, single-element, print head. This is accessible via the paper outlet slot on the front panel to facilitate easy cleaning and to achieve a high resolution print has 512 individual electrodes. These are spaced at 0,4 mm intervals and span almost the complete paper width giving a maximum line width of 205 mm.

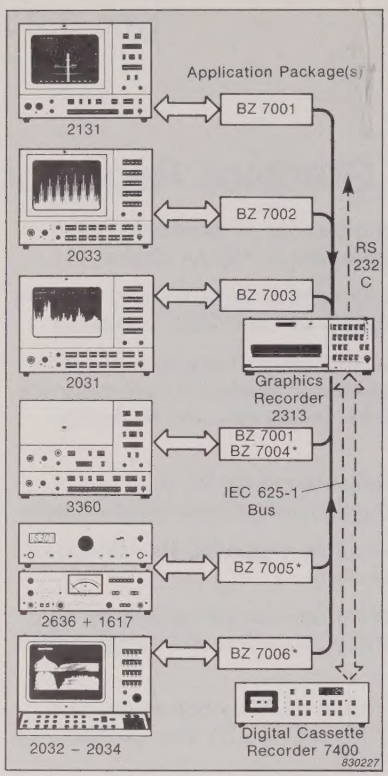



*Fig. 1. Interchangeable Application Packages and Digital Frequency Analyzers for use with the 2313. Packages planned for release in the near future, are marked with an asterisk*

For well formed characters and graphics, the paper is evenly accelerated and decelerated past the print head in 0,2 mm steps. Utilizing the plot mode for 512-point graphics, the maximum print rate is 46 lines per second. Due to the relatively smooth transition from one line to the next, relatively quiet operation is obtained.

In the print mode a total of 96 standard upper and lower case characters may be called on, plus 32 special characters. These are according to ISO 646 and 2022 standards respectively, and are based on a 6 by 8 point matrix. For enhancing different text four character sizes up to 12,8 mm may be chosen, which enable between 46 and 85 characters per line to be printed. In addition line spacings between 0,4 and 2,8 mm may be selected. The print rate depends on the size and number of characters printed and is between 3 and 9 lines per second.

If required text and graphics can be mixed by changing from the print to plot mode (or vice versa) at the start of a new line. Text and graphics may also be justified to the left or right margin of the paper and for filing in standard binders there is a "Page Feed" function for advancing the paper the remainder of one A4 or 11 inch chart.

## Application Packages

As standard the Application Package BZ 7000 is included with the 2313. This plugs directly into a port on the front of the Recorder and is the first of a range of interchangeable Application Packages which are planned for release in the near future.

Whereas BZ 7000 facilitates use as a conventional alphanumeric printer/-graphics recorder, the Application Packages BZ 7001 to BZ 7006 (see Fig.1) are designed especially to suit the individual documentation needs of B&K Digital Frequency Analyzers. In addition, BZ 7001 to BZ 7006 provide the 2313 with a range of special functions for storage and reformatting of data, which enable new types of measurement to be made using the analysis equipment shown.

**Note:** For direct copying of measurements presented on the display screen of the B&K Dual Channel Signal Analyzers Types 2032 and 2034, any Application Package may be employed, including BZ 7000.

## Documentation

Common to all Application Packages, except BZ 7000, are "List" and "Plot" functions. Both are selectable using the pushkeys of the Recorder and provide fully annotated, hard-copy documentation of measured frequency spectra and/or time domain functions in as little as 10 seconds. Examples of the two types of documentation are shown in Fig.2 and 3 respectively. Generally graphic plots of spectra resemble those presented on the display screen of B&K Digital Frequency Analyzers, except that they also have fully annotated measurement axes and include front panel control setting information plus the date and time of the readout.

If desired two separate spectra can be plotted simultaneously. Also, documentation may be modified to suit the specific signal analyzed. The latter is accomplished by selecting any one of three independent "Operating Set-ups" stored in the Recorder. These provide access to the different control functions of the particular package employed, permitting the user to change or select individual control parameters using the pushkeys of the Recorder. For example, different amplitude axes and offsets may be chosen or autoranged to correspond

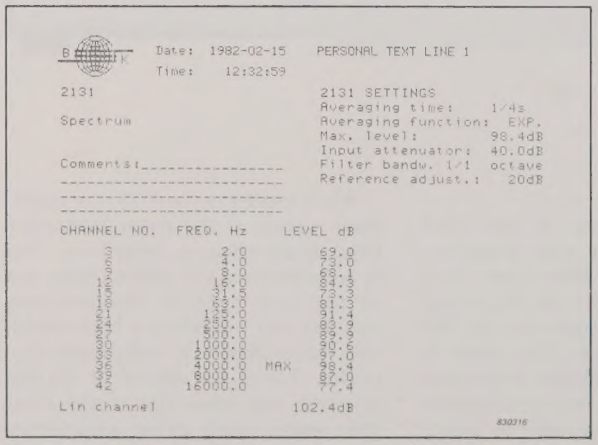



*Fig.2. Typical listing of 1/1 octave analysis data, printed by the 2313 Graphics Recorder with Application Package BZ 7001*

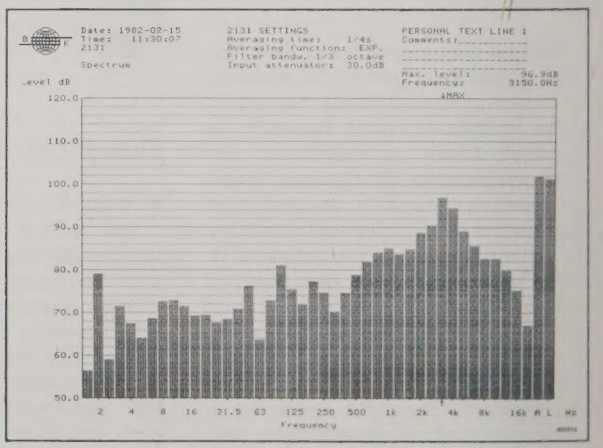



*Fig. 3. Typical 1/3 octave analysis, printed by the 2313 Graphics Recorder with Application Package BZ 7001*

with the maximum signal level, only data within a user-defined frequency range printed, and measurement axes graduated directly in dB and Hz or standard engineering units of Pa, $ms^{-2}$, mV etc.

### Storage

The 2313 includes both continuous and volatile memories. These enable measured spectra and other data transmitted by particular equipment for which the Application Package is designed, to be individually filed during the course of measurements. Stored spectra may then be recalled at some other time for comparison with later incoming data or may be saved and reformatted for new types of measurement.

With the continuous memory approximately ten sets of complete spectra may be stored, whilst with the volatile memory storage of several hundred sets is possible (see Specifications). Also, a 100 step pushkey sequence can be entered, enabling a whole series of measurement, storage and documentation functions to be carried out completely automatically. For identification and quick location of data, a "Memory Menu" function can be activated which lists file numbers along with other main data concerning stored measurements.

To help safeguard stored data, special provision is made for securing consecutive memory files. Whereas the volatile memory is intended only for temporary storage, data stored in the continuous memory can be retained more-or-less indefinitely provided that the 2313 is subjected to regular use.

### Measurements

An important feature of the 2313 is that it is capable of reformatting stored and incoming spectra, enabling new types of measurement to be documented, without having to use or especially program other equipment for the purpose.

The different types of measurement available cover production of sum, difference and average spectra, sound contour and 3D plots, 3-parameter (amplitude/frequency/time) mapping of single events etc. Furthermore, 1/1 or 1/3 octave spectra may be assembled from narrow-band data transmitted by Frequency Analyzers Types 2031 and 2033, or a 1/12 octave – 4 pass analysis carried out in conjunction with Frequency Analyzer Type 2131. See Fig.4 and Specifications.

Stored spectra may also be individually modified using the pushkeys of the Recorder. This is valuable for eliminating unwanted components, as well as for generating different reference spectra for comparison with incoming data.

### Built-in Clock

All internal operating sequences are governed by a built-in clock generator. For data logging purposes there is a calendar function enabling both date and time to be automatically recorded at the head of each data file stored or documented with the Recorder. If need be the clock may be set to initiate a series of readouts at preselected intervals ranging from 1s to 24 hours, and/or start a control sequence after both a preset level and time have been exceeded. This is useful in airport noise surveys, machine surveillance for preventive maintenance etc.

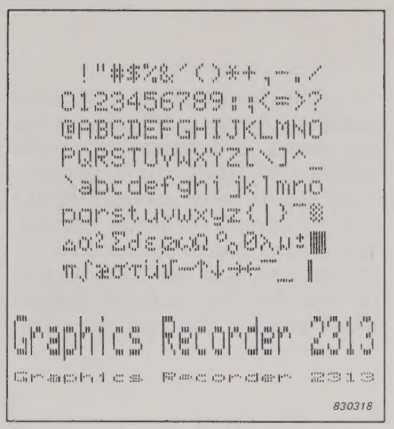



*Fig. 6. Alphanumeric characters available with the 2313 Graphics Recorder*

### Digital Interface and System Control

System control, plus digital input and output of measurement data, takes place via the IEC/IEEE Interface of the 2313. This enables a large number of instruments with compatible interface to be connected directly on-line with the Recorder. However, where more than digital input of data and manual operation of the measuring system is required, the 2313 must be fitted with an Application Package other than BZ 7000.

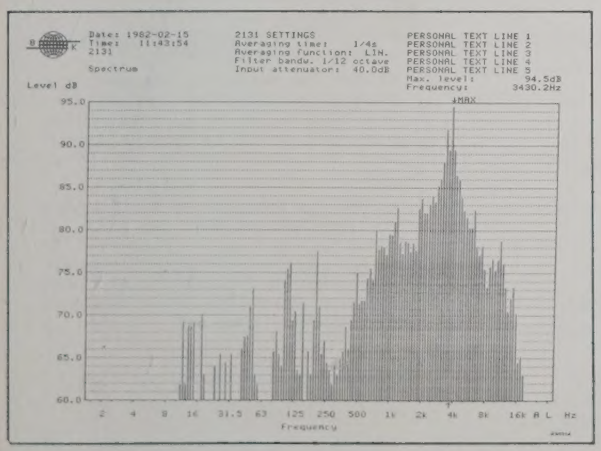



*Fig. 4. Typical 1/12 octave – 4 pass analysis obtained using the 2313 Graphics Recorder with Application Package BZ 7001*

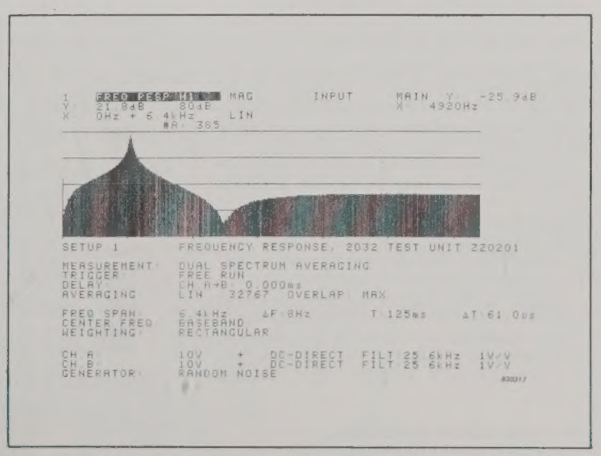



*Fig. 5. Typical graphics plot printed directly from the 2032 (or 2034) Signal Analyzer using the 2313 as a conventional graphics recorder with Application Package BZ 7000*

A notable feature of the Application Packages BZ 7001 to BZ 7006, is that they permit all information transfer over the IEC /IEEE bus of the measuring system to be governed by the 2313. As a result the entire measurement system may be operated via the interface and front panel pushkeys of the Recorder. For instance, using a simple pushkey command, measurements displayed on the Frequency Analyzer may be sent to the Recorder for documentation or storage, or if required may be relayed to another device such as a 7400 Digital Cassette Recorder. Similarly, tape recorded data may be documented or stored in one of the continuous or volatile memories of the 2313, provided that this originates from the Frequency Analyzer for which the Application Package is designed.

Provided along side the IEC interface, is an RS-232C serial interface. This is intended for entry of personal text in the print out of the Recorder (see Fig. 4). Alternatively, personal text may entered via the front panel pushkeys of the 2313.

# Specifications 2313

**WRITING SYSTEM:**
Dot-matrix printing on Electrosensitive Paper QP 4690 using fixed 512-point print head with line width of 205 mm

**Print Mode:**
96 standard plus 32 special 6 by 8 matrix characters according to ISO 646 and 2022
**Characters per Line:** Selectable between 46 and 85
**Character Height:** Selectable 1,6; 3,2; 6,4 or 12,8 mm
**Line Spacing:** 0,4 to 2,8 mm
**Print Rate:** 3 full lines of 3,2 mm high characters per second corresponding to 250 characters per second

**Graphics Mode:**
**Resolution:** 25 dots/cm (63 dots/in)
**Line Width:** 204,4 mm
**Line Spacing:** 0,2 mm
**Print Rate:** 46 lines per second

**PAPER DRIVE:**
**Step Length:** 0,2 mm
**Chart length:** 297 mm A4 (metric) or 11 in (English) chart length
**Page:** Advances paper remainder of selected A4 or 11 in chart
**Out of Paper:** Warning printed plus paper drive automatically terminated at end of paper roll

**IEC 625-1 STANDARD INTERFACE:**
For system control plus digital input and output of data to be documented.

**Connector:** Standard 25-pin connector accepting Cable AO 0194 for connection to an IEC 625-1 interface system. Connection into an IEEE 488 interface system is made using Cable AO 0194 plus Adaptor AO 0195
**Functions Implemented:** Source Handshake (SH 1), Acceptor Handshake (AH 1), Talker (T 5), Listener (L 3), Service Request (SR 1), Remote Local (RL 1), Parallel Poll (PP 1), Device Clear (DC 1), Controller (C 1 to 5)
**Transmission Speed:** ~100 kbytes/s with direct memory access
**System Control:** Manual operation or use as system controller in accordance with Application Package
**Job Specifications:** Accepts job specification commands in IEC 625-2/IEEE Std. 728 format

**RS-232C SERIAL INTERFACE:**
For digital input of personal text
**Connector:** 25-pin (female) wired as DCE device
**Transmission Speed:** Selectable up to 9600 Baud

**REMOTE CONTROL:**
8-pin DIN socket providing make and break lines for control of external sound source, audible alarm, warning lamp etc. Maximum throughput 0,25 mA/200V

**TEMPERATURE RANGE:**
**Operation:** 5 to 40°C (41 to 104°F)
**Storage:** –25 to 70°C (–13 to 158°F)

**HUMIDITY:** up to 90% RH (non condensing)

**ELECTROMAGNETIC COMPATIBILITY:**
Complies with Class B Device of the American FCC Rules

**POWER REQUIREMENTS:**
Complies with IEC 348 Safety Class II
**Supply Voltage:** 100; 115; 127; 200; 220; 240 V (50 to 60 Hz) ± 10% AC
**Power Consumption:** 60 VA nominal (160 VA max. instantaneous)

**CABINET:**
Supplied as Model A (light-weight metal cabinet) or Model C (as A but with flanges for standard 19 in rack)

**DIMENSIONS:**
Metal cabinet, excluding knobs and feet
**Height:** 177 mm (7,0 in)
**Width:** 430 mm (16,9 in)
**Depth:** 500 mm (19,7 in)

**WEIGHT:** 17 kg (37,5 lb)

**ACCESSORIES INCLUDED:**
1 × Mains Cable..... AN 0020
2 × 50 m Roll of Recording Paper..... QP 4690
1 × 8-pin DIN Plug..... JP 0802
1 × 25-pin IEC 625-1 Bus Connector Kit..... UA 0793
1 × 25-pin RS-232C Male Connector..... JP 2500
1 × Application Package..... BZ 7000

**ACCESSORIES AVAILABLE:**
50 m Roll of Recording Paper..... QP 4690
25-pin IEC 625-1 Interface Cable (2 m)..... AO 0194
25-pin IEC (male, slide-lock) to IEC 625-1 Interface Cable (2 m)..... AO 0184
25-pin Adaptor for coupling into IEEE 488 Interface System..... AO 0195

**APPLICATION PACKAGES AVAILABLE:**

**BZ 7001 for Digital Frequency Analyzer Type 2131 and Sound Intensity Analyzer System Type 3360.** Lists and plots 1/1 and 1/3 octave spectra. Stores 200 spectra plus 1 auto. control sequence. Genenerates "Lin" and "A"-weight channel – adds, subtracts and averages spectra – multiple plots of up to 40 spectra – 1/12 octave analyses – reverberation and decay measurements – 3-parameter (amplitude/frequency/time) maps. Clock, trigger and wait functions also included.

**BZ 7002 and 7003 for Digital Frequency Analyzers Type 2033 and 2031 respectively.** List and plot time functions plus narrow-band spectra. Stores approx. 60 spectra or 25×1k (2×10k) time functions, plus 1 auto. control sequence. Generate "Lin" and "A"-weight channel – 1/1 and 1/3 oct. spectra – distortion spectra – average spectrum and standard deviation. Also integration and differentation functions, as well as choice of autoscaling and engineering units.

**BZ 7004* for Sound Intensity Analyzer System Type 3360.** Similar to BZ 7001, but with sound power measurements, sound contour and 3D plots (pressure and intensity) and source localization instead of 3-parameter mapping, average and multiple plots.

**BZ 7005* for Measuring Amplifier Type 2636 plus Band Pass Filter Type 1617.** Similar to BZ 7001, but with $L_{eq}$ measurements, autoranging of 2636 for extended dynamic range, plus remote control of 1617 and BT product

**BZ 7006* for Dual Channel Signal Analyzers Types 2032 and 2034**

For more detailed information and specifications concerning the respective Application Packages, please consult your local B&K representative.

* Planned for release in the near future

# 2. CONTROLS

## 2.1. FRONT PANEL

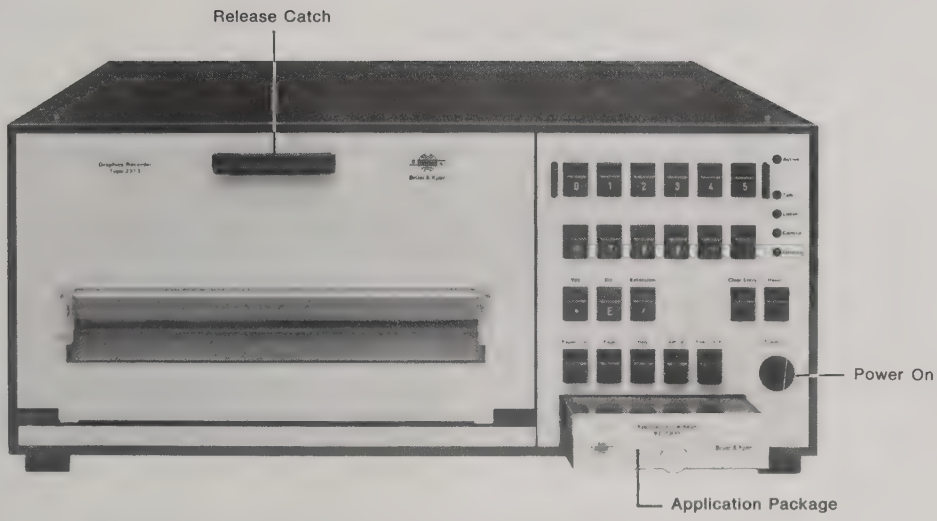



*Fig. 2.1. Front panel of the Graphics Recorder Type 2313*

**Power On**: "On"/"Off" switch for mains power. When first set to "On", either the **Active** or **Entering LED** at top-right corner of the instrument should light, accompanied by a print out of date and time.

**Release Catch**: Press down and pull forward for access to the paper drive mechanism and recording paper. See section 3.3 for paper loading.

**Application Package**: Plug-in module determining the documentation and control functions available with the 2313. For use as a conventional alphanumeric printer and graphics recorder, the Application Package BZ 7000 is included. See Chapter 1 for details on other Application Packages which may be fitted.

At the top right of the 2313 are two rows of dual function pushkeys. These are shown in Fig. 2.2 overleaf and when using Application Package BZ 7000 are reserved for entering the date and time with the built-in clock of the Recorder (see section 3.5). With the other Application Packages an individual Control Function Overlay is supplied which clips between the catches on either side of the top-most row of pushkeys.

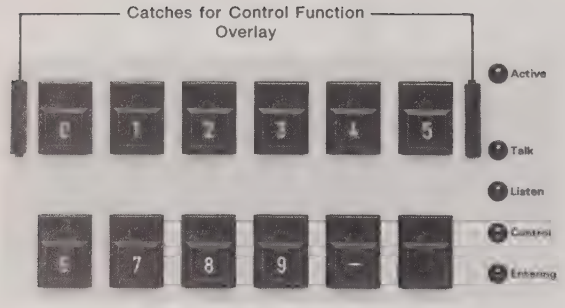



*Fig. 2.2. Top two rows of front panel pushkeys on Graphics Recorder Type 2313*

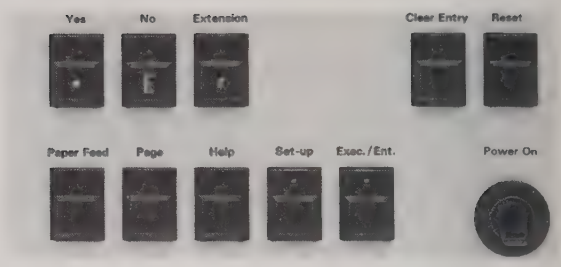
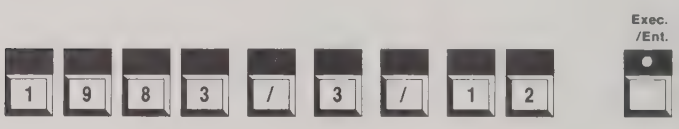



*Fig. 2.3. Bottom two rows of front panel pushkeys on Graphics Recorder Type 2313*

In Fig. 2.3 are shown the remaining pushkeys of the Recorder, the main functions of which are as follows:

**Yes** and **No:** For user communication and setting up of parameters with the Set-Up and Set Clock mode of the Recorder. The decimal point **[.]** and exponential **[E]** are secondary functions reserved for operation with Application Packages other than BZ 7000.

**Extension:** Extends the choice of functions available with the top two rows of pushkeys. Are also used to separate functions, parameters, numerical data etc., in order that they may be entered as a single string instead of individually. e.g.




**Clear Entry:** Deletes last command or numerical data entered using the top two rows of pushkeys. Permits false entry to be corrected prior to activating **Exec./Ent.**

**Reset:** Terminates selected function, returning the Recorder to normal standby status. See section 3.4.1 for other types of reset available.

**Paper Feed:** Advances paper as long as pushkey is held depressed. If **Exec./Ent.** is activated while **Paper Feed** key is held depressed, automatic self-test is activated. See section 3.4.2.

**Page:** Advances paper remainder of one full metric or english page depending on the setting of the **Address Switch** on the rear panel.

**Help:** Activates print-out of short-form data and instructions to aid entering commands and other data via the front panel pushkeys.

**Set-Up:** On-Off key, selecting the Set-Up mode ready for entry of the date and time of day with the built-in clock of the Recorder (see section 3.5). The built-in LED of the key plus the **Entering LED** light when the Set-Up mode is active.

**Exec./Ent:** Executes a command or terminates entry of data via the front panel pushkeys. The built-in LED of key lights when **Exec./Ent.** is activated and command execution is in progress.

**Active LED:** Lights when the Recorder is used as a system controller (e.g. **Address Switch** set for "System Controller Active"), and data is not being entered. Indicates that the Recorder is ready to accept a function via the front panel pushkeys of the instrument.

**Talk LED:** Lights when the Recorder is sending data over the IEC Interface.

**Listen LED:** Lights when the Recorder is receiving data over the IEC Interface.

**Control LED:** Lights when the Recorder is sending IEC control commands over the IEC Interface.

**Entering LED:** Lights when the Recorder is ready to accept numerical data entered via the front panel pushkeys of the instrument or sent over the IEC Interface.

## 2.2. REAR PANEL

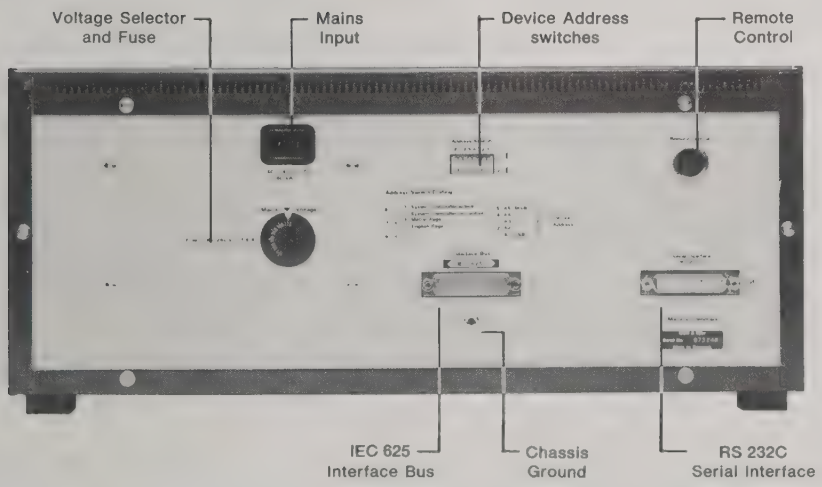



*Fig. 2.4. Rear panel of the Graphics Recorder Type 2313*

**Address Switch:** A set of eight miniature two-position rocker switches for manual selection of the device address number for the digital interface bus of the 2313, plus selection of "System Controller Active/Not Active" and "Metric/English" page length. On delivery the **Address Switch** numbers A5 to A1 are set to 00001 (ie., device address number 1). See section 4.3.1.

**Note:** With Application Package BZ 7000, the "System Controller Active" mode is reserved for automatic self-test of the Recorder. For operation as a conventional alphanumeric printer/graphics recorder, the "System Controller Not Active" mode is used. See sections 3.6 and 4.3.

**IEC 625 Interface Bus:**

25-pin connector conforming to IEC 625-1. Is used for digital input of data to be documented plus remote control of the Recorder via an IEC 625-1 or IEEE std. 488 digital interface bus system. See section 4.1 for details on appropriate interface cable.

**RS 232C Serial Interface:**

Not applicable with BZ 7000.

**Remote Control:**

Not applicable with BZ 7000.

**Voltage Selector and Fuse:**

Voltage selector for operation from a 100; 115; 127; 200; 220 or 240 V AC mains supply. The selector also contains a slow blow mains fuse. To select the appropriate voltage setting and fit the correct fuse, see section 3.1.3.

**Mains Input:**

2-pin socket accepting the Power Cable AN 0020 provided for connection of an AC mains supply. Before connecting a supply, the mains voltage setting and fuse checks given in section 3.1.3 should be carried out to ensure safe operation of the instrument.

# 3. PRELIMINARY

## 3.1. PRELIMINARY

### 3.1.1. Enviroment and Handling

The Graphics Recorder Type 2313 is designed for indoor use at temperatures from +10 to +40°C (+50 to +104°F) and humidities up to 90% RH (non-condensing). For safe operation avoid use in volatile environments and before each use of the instrument check that it is set to match the available supply voltage as described in section 3.1.3.

To ensure reliable operation of the 2313, it is important that the following be observed:

- When first using the 2313 keep it powered for approximately 14 hours to prevent loss of data stored in its continuous memory.
- If the 2313 is not to be used for 4 weeks or more, disconnect the internal Ni-Cd battery used to power its continuous memory (see section 3.1.4).
- For optimal reproduction of printed data regularly clean the print head of the 2313 as described in section 3.3. Avoid use of chemical cleaning agents and sharp tools, as these can damage the print head.

### 3.1.2. Rack Mounting

The 2313 may be used free-standing on its four plastic feet or, with the addition of the Flanges KS 0024 available, may be mounted in a 19 inch instrumentation rack. The flanges fasten via two screw holes at the front of the instrument side panels. These are accessible on easing back the bottom panel which is fastened by two screws on the rear of the instrument, plus removing the plastic corner pieces and sliding out the grooved plastic strips at the front of the side panels. Before releasing the bottom panel ensure that 2313 is disconnected from the mains supply.

### 3.1.3. Connection of Mains Supply

Before connecting a mains supply, the following mains voltage setting and fuse checks should be carried out to ensure safe operation of the instrument.

#### Mains Voltage Setting

The 2313 may be powered from 100, 115, 127, 200, 220 and 240 V ±10% (50 to 60 Hz) single phase AC mains lines. To select the correct mains voltage setting, use a small screwdriver to push in and release the fuse holder at the centre of the **Mains Voltage**

**Selector** on the rear panel. Pull the fuse holder straight out and using a small coin or wide-blade screwdriver turn the selector disc with so that the appropriate voltage setting lines up with the black arrow printed on the panel.

### Fuse Rating

To check or replace the mains fuse, release and withdraw the fuse holder at the centre of the **Voltage Selector**. For operation from 100 to 240 V AC supplies the fuse should be a 1,6 A slow blow (B & K no. VF 0007). Make sure that only fuses with the required rated current and of the specified type are used for replacement. The use of mended fuses and the short circuiting of fuse holders should be avoided.

### Supply Connections

Once the mains voltage setting and fuse have been checked, the mains supply may be connected to the **Mains Input** socket of the 2313 using the Power Cable AN 0020 supplied. The 2313 has a high standard of safety insulation in accordance with safety class II of IEC 348 and therefore its chassis need not be connected to mains ground.

## 3.1.4. Connection of Continuous Memory Supply

Both the continuous memory and built-in clock of the 2313 are powered by a rechargeable Ni-Cd battery. As standard this is supplied already wired in the 2313, but to avoid unnecessary power drain during storage and shipment is internally disconnected from the instrument.

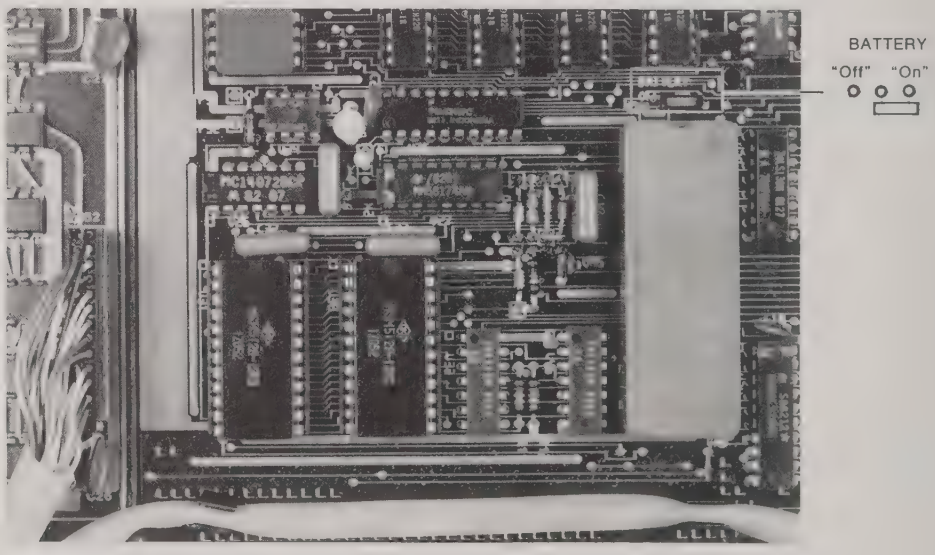



*Fig. 3.1. Contact clip for connecting and disconnecting the internal Ni-Cd battery used to power the continuous memory of the 2313*

To connect the Ni-Cd battery, disconnect the mains supply from the 2313 and remove its top panel which is fastened by two screws on the rear of the cabinet. The battery is located on the main circuit board on the base of the instrument. It may be connected by sliding off the contact clip from the group of three pins shown in Fig. 3.1 and using it to connect the centre pin and pin marked "On".

For recharging the Ni-Cd battery, the 2313 has its own charging circuit built-in. This is operative as long as the 2313 is powered from a mains supply and keeps the continuous memory powered more or less indefinitely provided that the 2313 is subjected to approximately 30 minutes use each day, 3,5 hours use each week or 14 hours every 4 weeks. However, when using the 2313 for the first time it should be kept powered for at least 14 hours to ensure that the battery attains full charge capacity.

**WARNING!** To prevent damage to the battery ensure that it is regularly charged. If the 2313 is not to be used for more than 4 weeks, then recharge the battery for approximately 14 hours and disconnect it as described above.

### 3.1.5. Grounding Considerations

Indiscriminate grounding of instruments can introduce ground loop interference. To prevent this it is necessary to ensure that the 2313 and the measuring or analyzing instruments with which it is used, are grounded at one point only in the measurement system. To do this without prejudicing the operating safety of the instruments, proceed as follows:

1. Connect the signal ground lines of all instruments together. This is done automatically through the screens of the input and output cables used to interconnect the instruments.

2. Where the same instruments are interconnected by more than one signal cable or combination of signal and remote control cables each containing a signal ground connection, keep the cables short and close together or disconnect the signal ground line of all but one of them.

3. Where instruments are interconnected by a digital interface cable containing a chassis ground connection, check that one and only one of these instruments has its signal ground or digital ground connected to chassis (and chassis connected to mains ground if equipped with a mains connector having a protective earth - chassis contact).

4. Where the measurement arrangement is used free-standing without the instrument cabinets touching, check that each of the other instruments in the measurement arrangement has its chassis connected to a) mains ground only or b) signal ground or digital ground only. With instruments equipped with a mains connector having a protective earth-chassis contact, a) is to be preferred.

5. Where the measurement arrangement is mounted in an instrumentation rack, ensure that one and only one of the instruments has its signal ground or digital ground connected to chassis (and chassis connected to mains ground if equipped with a mains connector having a protective earth - chassis contact). If more than one of the instruments has a permanent signal ground - chassis connection, then isolate the cabinets of these instruments from the rack.

6. Where the signal ground line is connected to mains ground via the mains connector of one of the instruments, isolate the housing of the measurement transducer from grounded measurement sources.

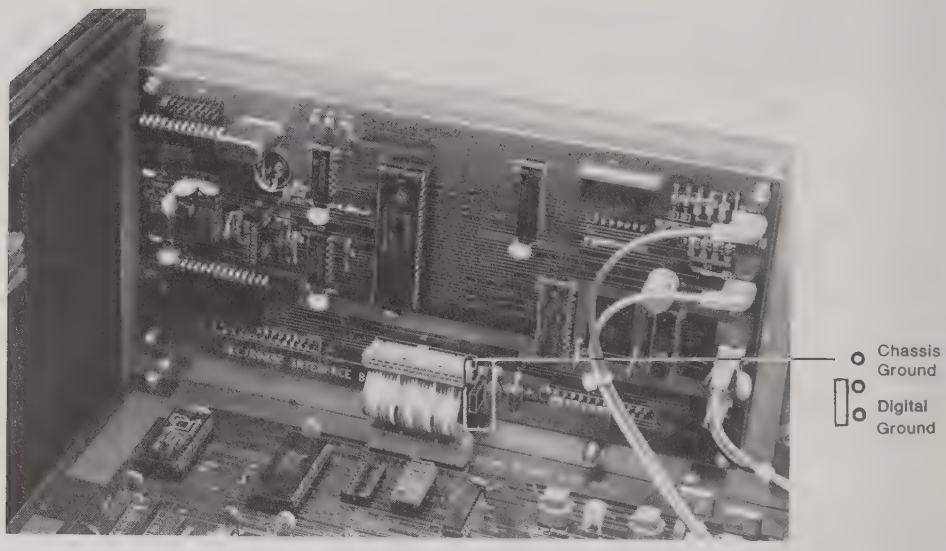



*Fig. 3.2. The digital ground and chassis ground contacts of the 2313*

As standard the 2313 is delivered with its digital ground connected to chassis, which is that normally required for operation in most instrument set-ups. However, where the above grounding requirements dictate, they may be disconnected from one another by carefully easing off the contact clip from the interface board contacts shown in Fig. 3.2 and using it to connect the top and middle contacts indicated. The interface board is mounted on the rear panel and is accessible on sliding off the top panel which is fastened by two screws at the back of the instrument. Before removing the top panel ensure that 2313 is disconnected from the mains supply.

**WARNING!** The 2313 is designed to be operated with its digital ground and chassis at zero earth potential. Never let the signal ground terminals, socket screens or chassis float at other than approximately zero earth potential, as this will impair the operating safety of the apparatus and may damage it.

### 3.2. INSTALLATION OF APPLICATION PACKAGE

As standard the 2313 is equipped with an Application Package BZ 7000. This is intended for use of the 2313 as a conventional Alphanumeric Printer/Graphics Recorder and plugs directly in the port immediately below the pushkeys of the 2313 as shown in Fig. 3.3. Once inserted, tighten the knurled fastening on the front of the Package to ensure that it properly secured.

Where BZ 7000 is to be used in place of one of the other Application Packages available (see Chapter 1), it is advisable to check the contents of the continuous and volatile memories of the Recorder. If important data from previous measurements is present in the memories, then this should be recorded on tape using the 7400 Digital Cassette Recorder (see Instruction Manual for particular Application Package used). This is necessary as stored data will be automatically deleted when BZ 7000 or another Package is fitted.

**Note:** To prevent ingress of dust and other foreign matter avoid leaving the 2313 without an Application Package fitted. Also protect Packages not in use by keeping them in their mahogany case.

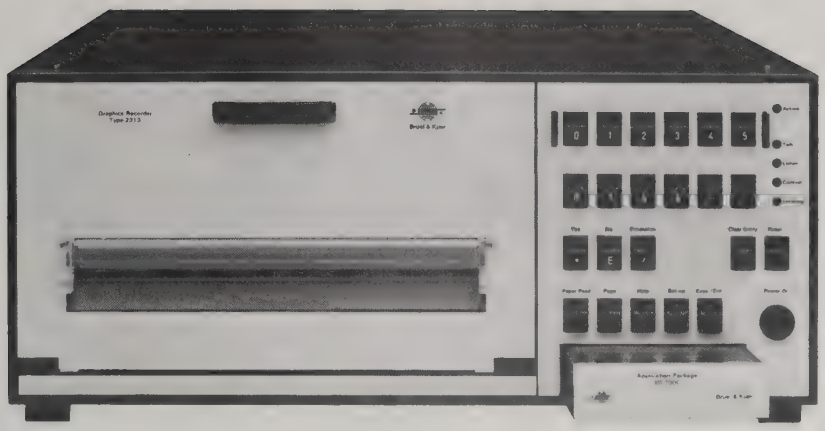


*Fig. 3.3. Installation of Application Package*

### 3.3. PAPER LOADING AND CLEANING OF THE PRINT HEAD

To load the 2313 with a fresh roll of Paper QP 4690, proceed as follows:

1. Press down the **Release Catch** on the front panel and pull forward the paper drive frame as shown in Fig. 3.4.

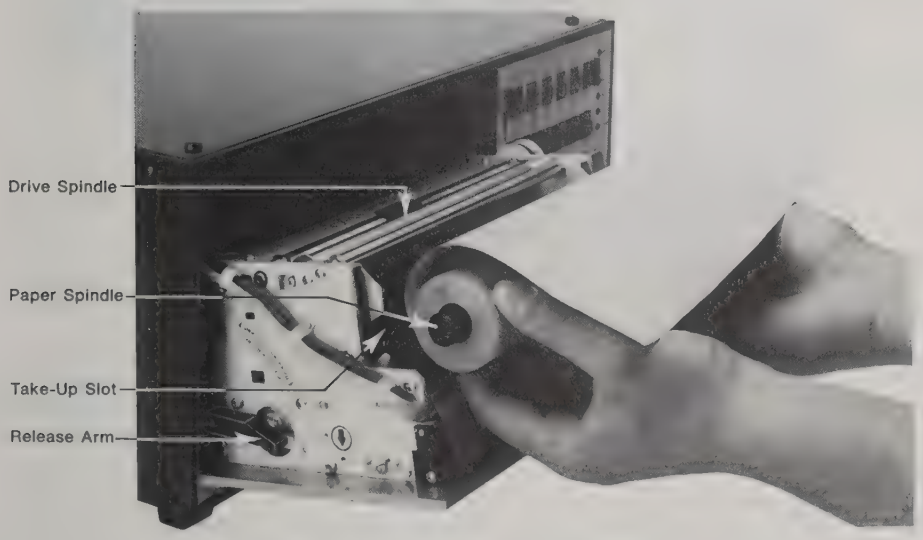



*Fig. 3.4. The Paper Drive Frame of the 2313*

2. Lower the **Release Arm** on the left of the drive frame and lift out the paper spindle together with the remainder of the old paper roll if one is fitted.

3. Wipe a soft lint-free cloth along the rear of the print head to remove traces of print dust which may have accummulated during previous use. See Fig. 3.5.

4. Slide a fresh roll of Paper QP 4690 onto the paper spindle and position it so that its adhesive label is on top of the roll with arrow pointing towards the front panel. See Fig. 3.4.

5. Holding the roll of paper in the position indicated in Fig. 3.4 fit it in the empty **Take-Up Slots** on either side of the drive frame and check that the spindle clips fast on the ball-catches in the slots.

6. Remove the adhesive label and pull out approximately 30 cm (12 in) of paper from the roll.

7. Carefully feed the free end of the paper between the guide and drive spindles until it protrudes from the opening on the front panel of the drive frame.

8. Lightly pull the free end of the paper to take up any slackness and raise the **Release Arm** on the left of the drive frame to lock the pressure spindle.

9. Hinge up the front of the drive frame so that it is flush with the front panel of the 2313 and push the **Release Catch** up to lock.

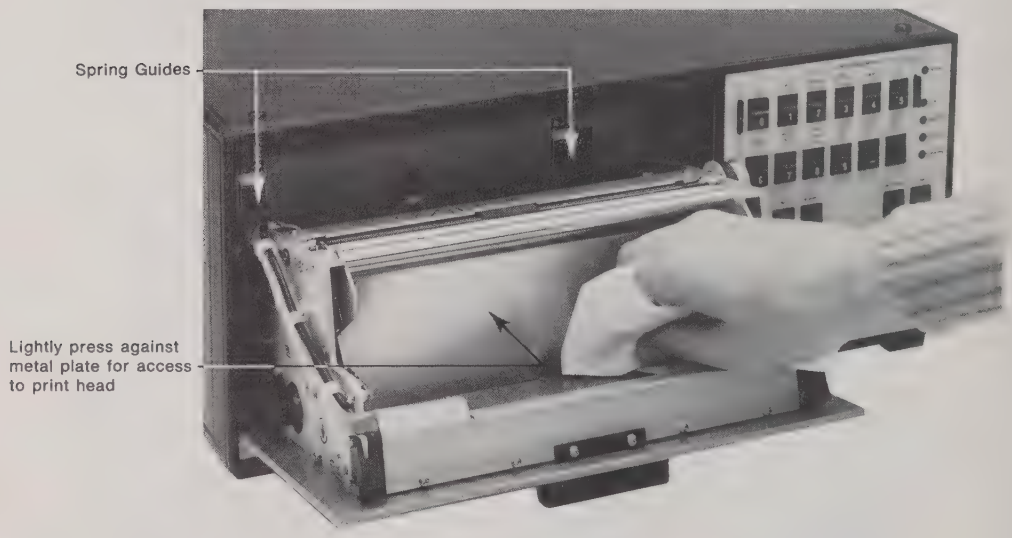



*Fig. 3.5. Cleaning the Print Head of the 2313*

After loading a fresh roll of recording paper it is recommended that the Self-Test mode of the 2313 be activated as outlined in section 3.4.2. Provided that Recorder is functioning correctly then it should generate an exact replica of the test print shown in Fig.3.6.

Should the test print show signs of uneven printing or lack contrast, then it is likely that there are more firmly embedded traces of print dust on the print head. These may be removed by lightly brushing with a soft bristled tooth brush and wiping with a lint-free cloth as shown in Fig. 3.5. For access to the print head carry out items 1 and 2 above and gently press the metal plate at the rear of the writing system to move it 1 or 2 mm away from the head.

If the paper starts to run slightly out of alignment, causing it curl or fold at either its left or right-hand edges, then it is possible that the spring guides at the rear of the writing system compartment require attention (see Fig. 3.5). Normally this is not a frequent occurence and can easily be rectified by gripping the bottom of the guide nearest the faulty edge of the paper and bending it out slightly so that it makes proper contact with the paper when the writing system is folded back into the Recorder.

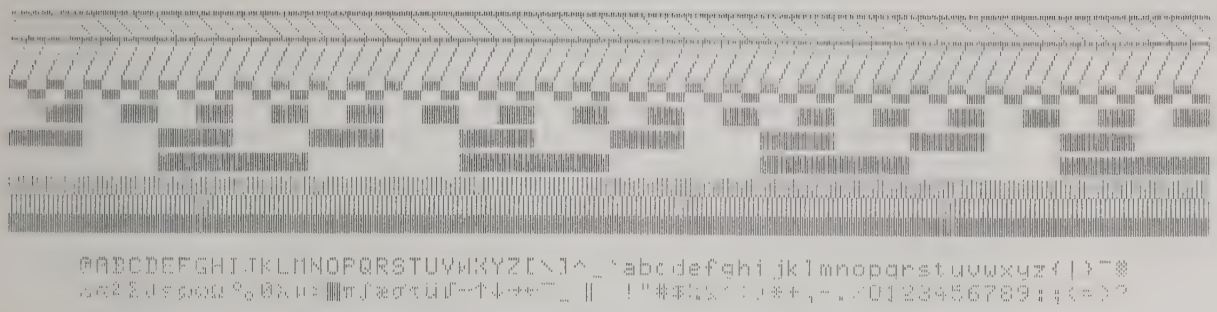


*Fig. 3.6. Test print obtained using the Self-Test mode of the 2313*

## 3.4. USE OF RESET AND AUTOMATIC SELF–TEST

### 3.4.1. Reset

The **Reset** pushkey is useful for quickly terminating execution of a control function following choice of an incorrect function or one that is not self terminating. In such circumstances, pressing the **Reset** key will return the 2313 to normal standby status where selection of a new function is possible.

Another use of the **Reset** pushkey is in ensuring that the 2313 always selects the appropriate control mode following alteration of its **Address Switch**. In addition, it is capable of restoring normal operation of the Recorder when this has been blocked by a minor malfunction or mains interference. However, whether this use of the **Reset** key is successful or not largely depends on type of disturbance. If not successful, normal operation can usually be restored by selecting **Power Off** for a couple of seconds and then selecting **Power On**. This has the effect of performing a *power on reset*, which returns the 2313 to its initial power on status, deleting measurement data stored in its volatile memory. An alternative method of performing a *power on reset* is as part of Self-Test, and is described in section 3.4.2.

Yet another means of restoring normal operation after a minor malfunction is by pressing the **Paper Feed** pushkey and whilst keeping it pressed, momentarily pressing **Reset**. This performs a *hard reset* which resets the entire instrument including its built-in clock, plus deletes all measurement data in its volatile and continuous memories. A *hard reset* should therefore only be performed after having tried the other methods of reset described.

If the 2313 fails to respond correctly even after a *hard reset*, then it is likely that a more serious fault has occurred. To check the Recorder plus the Application Package the Self-Test mode discussed in section 3.4.2 can be employed.

### 3.4.2. Automatic Self-Test

For checking the correct function of the 2313, it is equipped with a Self-Test mode. This may be activated in two ways, the simplest of which is by pressing the extreme right-hand key in the second from top row of pushkeys and while keeping it depressed, momentarily pressing **Reset**. The 2313 then starts the test cycle described below and on completion of the tests performs a *power on reset* which returns the 2313 to normal power on status plus deletes measurement data stored in the volatile memory of the instrument.

Where it is important that stored data not be deleted, Self-Test can be activated to provide a print out of a test chart instead. This is provided at the start of the test cycle and useful in checking the writing system of the Recorder (see section 3.3). It is chosen by pressing the **Paper Feed** pushkey and while keeping it depressed, pressing **Exec./Ent.** However, first it is important that the "System Controller Active" mode be selected by setting **Address Switch** number 8 on the rear panel to "1" (see Fig. 3.9) and pressing the **Reset** pushkey.

Having carried out the above, the Self-Test mode lights all five control LEDs in the top right corner of the front panel and proceeds to check the electronic circuitry of the Recorder and Application Package. On satisfactorily completing each check it automatically extinguishes the relevant control LED. It then continues with the next check until finally only the **Active LED** remains lit, indicating that the test sequence is completed and that the Recorder has returned to normal operating status.

Provided that the 2313 is functioning correctly, the entire test sequence takes approximately 75 seconds to carry out. If, however, a fault is detected then the test sequence will be permanently interrupted. At the same time the relevant control LED for the test plus those yet to be completed will flash, warning that a fault is present.

Where Self-Test is automatically interrupted and only the Entering and Control LEDs remain extinguished, then it is likely that only the Application Package is at fault. To check whether this is the case disconnect mains power and reactivate Self-Test with another Package fitted. For repair of the Recorder and/or Application Package, please contact your local B&K service representative. Under no circumstances should repair be attempted by persons not qualified in the service of electronic equipment.

## 3.5. SET CLOCK AND CALENDAR FUNCTIONS

For correct documentation of date and time, the built-in clock of the 2313 must be properly set. This is accomplished as described below and employs the pushkey set-up sequence illustrated in Fig. 3.7.

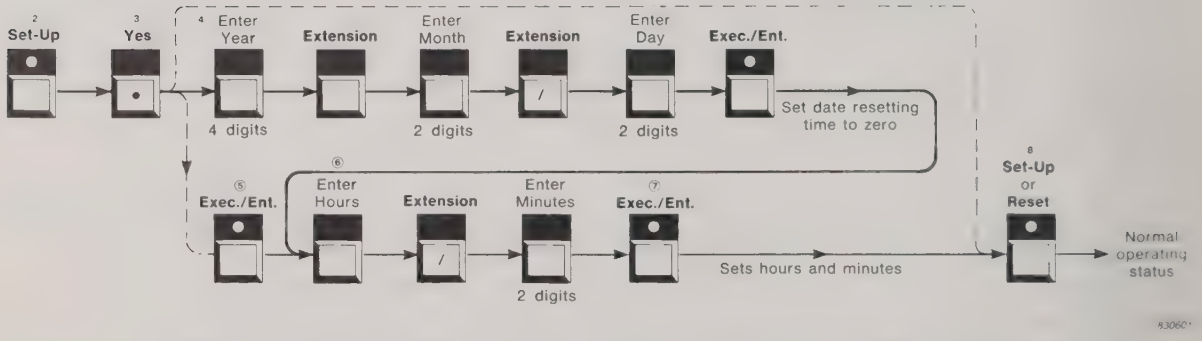



*Fig. 3.7. Use of the Set-Up mode for setting date and time with the 2313*

1. Select **Power On**. Either the **Active** or **Entering LED** will light, followed by a printout of the date and time set with the internal clock.

```
DATE: 1983-06-01    TIME: 8:30:16
```

If `CONTINUOUS MEMORY AND CLOCK CLEARED` and/or `DATE: 9999-01-01` is printed, check that the internal Ni-Cd battery for the continuous memory is connected before proceeding with step 2. See section 3.1.4.

2. Press **Set-Up** to activate the set-up mode plus print the identity of the particular operating set-up selected. At the same time the **Set-Up** and **Entering LEDS** will light and the **Active LED** extinguished if previously lit.

```
Setup mode, active setup no: 0
```

**Note:** With Application Package BZ 7000 no operating set-ups are included. Consequently Set-Up No. 0 will always be printed when **Set-Up** is activated.

3. Press **Yes [.]** to activate the set clock mode, as well as print the date and time currently set.

```
Date: 1983-06-01    Time: 8:33:12    Enter Date
```

If both the date and time are correct, go to step 8 to return the 2313 to its initial operating status.

If only the date is correct, press **Exec./Ent.** and go to step 6 to enter the correct time.

4. For entry of the correct date, key-in **[YEAR] [/] [MONTH] [/] [DAY]** in turn. e.g.

To correct a false entry, press **Clear Entry** to delete, and re-enter the **[YEAR] [/] [MONTH] [/] [DAY]**.

5. Press **Exec./Ent.** to set the clock to the entered date and reset the time to zero.

```
Date: 1983-06-12    Time: 00:00:00    Enter time
```

6. To enter the correct time, key-in **[HOURS] [/]** and **[MINUTES]** one minute ahead of actual time. e.g.

To correct a false entry, press **Clear Entry** to delete, and re-enter **[HOURS] [/] [MINUTES]**.

7. Wait until the actual time corresponds to the value entered and press **Exec./Ent.** to set the clock to the correct time.

```
Date: 1983-06-12    Time: 10:45:00    Enter date
```

If the time set is not quite correct, press **Exec./Ent.** one more time and return to step 6.

8. Once the date and time are accurately set, press **Set-Up** to return the 2313 to normal standby status. The **Set-Up LED** should extinguish and either the **Active** or **Entering LED** relit.

### 3.6. USE WITH SIGNAL ANALYZERS TYPES 2032 AND 2034

Together with BZ 7000, the 2313 is capable of producing hard-copy graphic plots of measurements displayed on the Dual Channel Frequency Analyzers Type 2032 and 2034. Each copy takes approximately 10 seconds to produce and is fully annotated so that there are no instrument control settings to note. The operating procedure is as outlined below.

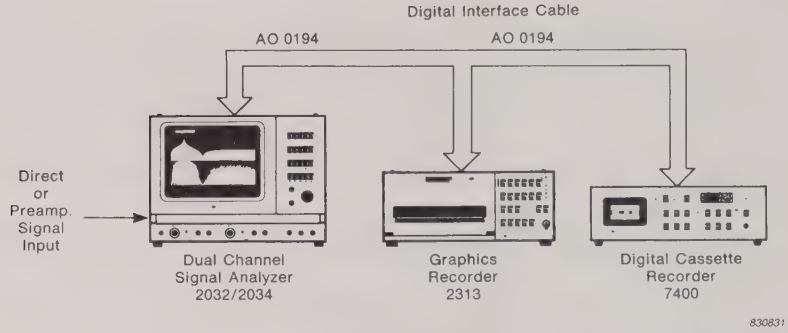



*Fig. 3.8. Use of the 2313 Graphics Recorder with a 2032 or 2034 Dual Channel Frequency Analyzer plus 7400 Digital Cassette Recorder*

1. Interconnect the IEC Interface Bus connectors of the 2313 and 2032 or 2034 using the Interface Cable AO 0194 as indicated in Fig. 3.8 and carry out the necessary preliminary adjustments on the instruments. See section 3.1 and the 2032 or 2034 Instruction Manual.

2. Fit the 2313 with Application Package BZ 7000 plus a roll of Recording Paper QP 4690 if these are not already fitted. See sections 3.2 and 3.3 respectively.

3. Check that the "System Controller Not Active" mode plus appropriate "Metric" or "English" chart length are selected with the **Address Switch** on the rear panel of the 2313. See Fig. 3.9.

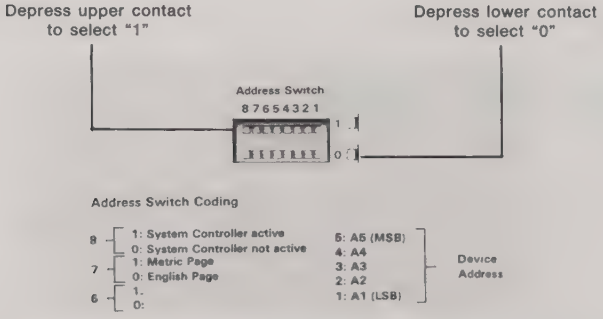



*Fig. 3.9. Selection of "System Controller Active/Not Active" modes plus "Metric" or "English" chart length with the Device Address switches of the 2313*

4. Select **Power On** and set the 2032 or 2034 so that the desired measurement to be documented is displayed on the Analyzer.

5. Press **Reset** followed by **Exec./Ent.** on the 2313, to select its listener mode. The **Exec./Ent.**, **Entering** and **Listen LEDs** should light, indicating that the Recorder is ready for documenting measurements.

6. If a 7400 Digital Cassette Recorder is connected, activate its **Stop** key to prevent recording with the 7400.

7. A hard copy of the measurement displayed on the 2032 or 2034 will now be obtained each time **DIGITAL I/O "Plot"** is selected on the Analyzer. On completion of the hard copy, **DIGITAL I/O "Stop"** will be automatically selected. Alternatively, the copy can be stopped before its completion by pressing **DIGITAL I/O "Stop".**

8. To deactivate the 2313, press its **Reset** key. This may be necessary when transferring data between the 7400 and 2032 or 2034.

**Note:** If at any time the 2313 fails to respond as described, press Reset and repeat the particular operation. If correct operation is still not possible then a hard reset may needed to resume normal operation. See section 3.4.1.

## 3.7. USE WITH DIGITAL CASSETTE RECORDER TYPE 7400

The Type 7400 Digital Cassette Recorder can be used for long term mass storage of data transmitted over the interface bus. Up to 500 kbytes of data can be stored on one tape cassette. As data is formatted according to the ECMA 34 standard, the tape can be read by other cassette recorders using this standard.

When the 7400 is connected into a system with the 2313, e.g., with a Type 2032 or 2034 as shown in Fig. 3.8, data intended for the 2313 can be recorded on the 7400 and sent to the 2313 at a later convenient stage.

To record data on tape using the 7400, proceed as follows:

1. Interconnect the INTERFACE BUS connectors of the 7400 and output device, e.g., Type 2032 or 2034 Dual Channel Signal Analyzer, using cable AO 0194 (or AO 0184 for a 7400 before serial no. 894938), and carry out the necessary preliminary adjustments to the instruments as outlined in their respective instruction manuals.

2. Set the INTERFACE MODE of the 7400 to "IEC".

3. Select **Power On** and set the 7400 to record data by referring to the 7400 instruction manual.

4. Activate the read-out of data from the output device. If this is a 2032 or 2034, ensure that the measurement is displayed on the screen and press the DIGITAL I/O "Plot" pushbutton. Data will then be stored on tape as a 'plot' file.

   **Note** that data read out of the 2032 or 2034 as a 'plot' file cannot be read back to the Analyzer. However, by activating the DIGITAL I/O "Output", the complete measurement results are read out and can be stored on tape as desired then read back to the Analyzer at a later stage. This reconstructs the measurement results on the Analyzer display screen which can be plotted on the 2313 as above.

The recorded data may be read back from the 7400 to the 2313 as follows:

1. Carry out steps 1 to 3 in Section 3.6 before selecting **Power On**.

2. Set the INTERFACE MODE of the 7400 to "IEC".

3. Press **Reset** followed by **Exec./Ent.** on the 2313, to select its listener mode. The **Exec./Ent.**, **Entering** and **Listen LEDs** should light, indicating that the Recorder is ready for documenting measurements.

4. Set the 7400 for read-out of data by referring to the 7400 Instruction Manual. The data will be plotted or printed by the 2313 depending on the stored data.

# 4. DATA TRANSFER OVER THE IEC INTERFACE

## 4.1. INTRODUCTION

The digital interface of the Type 2313 is designed according to the standard IEC 625-1 "Interface for Programmable Measuring Apparatus Byte-Serial Bit Parallel". Since the only significant difference between this and IEEE Standard 488 – 1978/ANSI MC1.1 – 1975 is the type of connector used, compatibility with these standards is only a question of which connecting cable is used. Connection of the Type 2313 to an IEC 625-1 interface bus system is made from the IEC BUS connector on the rear panel of the Type 2313 using cable AO 0194. Connection to an IEEE/ANSI interface bus system is made from the same connector using cable AO 0194 and adaptor AO 0195. Connection to an earlier B & K instrument fitted with a female, slide-lock connector, is made using cable AO 0184. For further details of instrument interconnections, refer to the B & K publication "INTERFACING BRÜEL & KJÆR INSTRUMENTS".

It is important to note that although the Type 2313 interface is designed according to the IEC standard, absolute compatibility with IEC or IEEE/ANSI interfaces designed by other manufacturers cannot be unconditionally guaranteed, since differences can occur within the limits of the specifications. Any problems encountered, however, will be of a software rather than a hardware nature. Where compatibility is in doubt, contact our local representative for details.

## 4.2. IEC FUNCTIONS IMPLEMENTED

The interface of the Type 2313 implements the following functions, as specified by the IEC standard. The clauses referred to are the relevant sections of the IEC publication specifying the functions. The equivalent sections in the IEEE/ANSI standard are given in parentheses.

Clause 6, Source Handshake (SH) Interface Function, (Section 2,3)
SH 1 — complete capability
Clause 7, Acceptor Handshake (AH) Interface Function, (Section 2,4)
AH 1 — complete capability
Clause 8, Talker (T) Interface Function, (Section 2,5)
T6 — basic talker, serial poll capability, unaddress if MLA
Clause 9, Listener (L) Interface Function, (Section 2,6)
L3 — complete capability
Clause 10, Service Request (SR) Interface Function, (Section 2,7)
SR 1 — complete capability
Clause 11, Remote Local (RL) Interface Function, (Section 2,8)
RL 1 — complete capability
Clause 12, Parallel Poll (PP) Interface Function, (Section 2,9)
PP 1 — remote configuration
Clause 13, Device Clear Interface (DC) Function, (Section 2,10)
DC 1 — complete capability
Clause 15, Controller Interface (C) Function, (Section 2,12)
C 1 — system controller
C 2 — send interface clear (IFC) and take charge
C 3 — send remote enable (REN)

C4 — respond to service request (SRQ)
C5 — send interface messages, receive control, pass control, pass control to self, parallel poll, take control synchronously

All other functions no capability

For further details of the above functions, refer to the relevant sections of the IEC or IEEE/ANSI standards.

### 4.3. ADDRESSING THE TYPE 2313

Each device in an IEC interface bus system has at least one listener and / or talker address depending on its function. When an interface controller contacts a device over the IEC interface, it sends a device address, which will contain the appropriate talker or listener address. This address is in ISO 7-bit code (or equivalent ASCII), bit 8 being unused for addressing, therefore remaining at logic 0. Table 4.1 gives a list of possible ADDRESS SWITCH settings with the corresponding device address in the form of ASCII characters for the different address modes.

| ASCII Address Characters | | ADDRESS SWITCH | | | | | Address Code | |
|---|---|---|---|---|---|---|---|---|
| Listen | Talk | A5 | A4 | A3 | A2 | A1 | decimal | octal |
| SP | @ | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ! | A | 0 | 0 | 0 | 0 | 1 | 1 | 1 |
| " | B | 0 | 0 | 0 | 1 | 0 | 2 | 2 |
| # | C | 0 | 0 | 0 | 1 | 1 | 3 | 3 |
| $ | D | 0 | 0 | 1 | 0 | 0 | 4 | 4 |
| % | E | 0 | 0 | 1 | 0 | 1 | 5 | 5 |
| & | F | 0 | 0 | 1 | 1 | 0 | 6 | 6 |
| ' | G | 0 | 0 | 1 | 1 | 1 | 7 | 7 |
| ( | H | 0 | 1 | 0 | 0 | 0 | 8 | 10 |
| ) | I | 0 | 1 | 0 | 0 | 1 | 9 | 11 |
| * | J | 0 | 1 | 0 | 1 | 0 | 10 | 12 |
| + | K | 0 | 1 | 0 | 1 | 1 | 11 | 13 |
| , | L | 0 | 1 | 1 | 0 | 0 | 12 | 14 |
| - | M | 0 | 1 | 1 | 0 | 1 | 13 | 15 |
| . | N | 0 | 1 | 1 | 1 | 0 | 14 | 16 |
| / | O | 0 | 1 | 1 | 1 | 1 | 15 | 17 |
| 0 | P | 1 | 0 | 0 | 0 | 0 | 16 | 20 |
| 1 | Q | 1 | 0 | 0 | 0 | 1 | 17 | 21 |
| 2 | R | 1 | 0 | 0 | 1 | 0 | 18 | 22 |
| 3 | S | 1 | 0 | 0 | 1 | 1 | 19 | 23 |
| 4 | T | 1 | 0 | 1 | 0 | 0 | 20 | 24 |
| 5 | U | 1 | 0 | 1 | 0 | 1 | 21 | 25 |
| 6 | V | 1 | 0 | 1 | 1 | 0 | 22 | 26 |
| 7 | W | 1 | 0 | 1 | 1 | 1 | 23 | 27 |
| 8 | X | 1 | 1 | 0 | 0 | 0 | 24 | 30 |
| 9 | Y | 1 | 1 | 0 | 0 | 1 | 25 | 31 |
| : | Z | 1 | 1 | 0 | 1 | 0 | 26 | 32 |
| ; | [ | 1 | 1 | 0 | 1 | 1 | 27 | 33 |
| < | \ | 1 | 1 | 1 | 0 | 0 | 28 | 34 |
| = | ] | 1 | 1 | 1 | 0 | 1 | 29 | 35 |
| > | ^ | 1 | 1 | 1 | 1 | 0 | 30 | 36 |

*Table 4.1. 2313 Address Switch settings (shaded area factory setting)*

Note that in a system where the Type 2313 is a controller, it is not necessary to set the address of the 2313 in order to operate the system. It will, however, be necessary to set the addresses of the other instruments in the system to their factory setting, which can be found in the relevant instruments instruction manual.

### 4.3.1 Setting the Address Switches

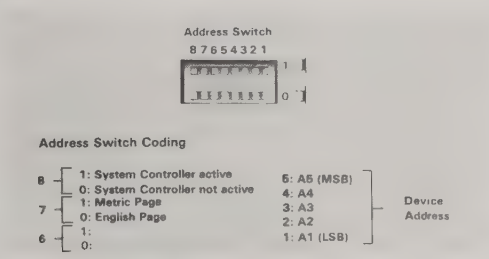



*Fig. 4.1. Address Switch on the rear panel of the 2313*

The listen and talk addresses over which the 2313 can be contacted via its IEC interface are selected by the **Address Switches** on the rear panel. For each switch pair, depressing the upper switch will give a logic 1 and depressing the lower switch will give a logic 0. The most significant bit (MSB) of the address is given by switch pair A5, while the least significant bit (LSB) is given by switch pair A1.

Switch pair 6 is unused whilst switch pair 7 is for setting the page size to 'English' or 'Metric'.

Switch pair 8 is for activating or deactivating the 2313 as a system controller. When set at logic 0 ("System Controller Not Active"), the system controller function of the 2313 is deactivated, which enables the "Listen Only" mode to be activated manually (Section 4.3.2), or enables the 2313 to print or plot data transferred over the interface bus. When set at logic 1 ("System Controller Active"), the system controller function is activated and the 2313 can be used via its front panel pushbuttons to control itself and other instruments depending on the Application Package used (see Section 1). With BZ 7000, the setting must be "System Controller Not Active" except when performing Self-Test.

On delivery, **Address Switch** numbers A 1 to A 5 on the rear panel of the Type 2313 are set to 00001. Other address codes may be selected as required without influencing the operation of the 2313.

**Note** that after activating any of the switches, it is necessary to press "Reset" or power off and then on again.

### 4.3.2. Listen Only Mode

In this mode, the 2313 will print out any data on the interface bus. This mode is accessed manually as follows:

1. Set switch pair 8 of the **Address Switch** on the back panel of the 2313 to "System Controller not active" and press **Reset**.

2. On the front panel of the 2313, press **Exec./Ent.**

The **Listen** LED will illuminate, indicating that the 2313 is in the "Listen Only" mode and ready to print data as described in Section 4.4.

### 4.3.3. Remote/Local Operation

Instead of manually controlling the 2313 you might control it via the interface bus. Three control modes exists:

Local Mode: The front panel controls can be used by the operator.

Remote Mode: The 2313 can be controlled from either the front panel or remotely.

Remote Mode with Local Lockout: Only remote control is possible.

### 4.3.4. Interface JOB

Section 4.3.2 describes how to manually bring the 2313 in a mode ready for performing the PRINTER job as described in Section 4.4. Various jobs can be specified, the syntax being of the form of that in Fig. 4.2.

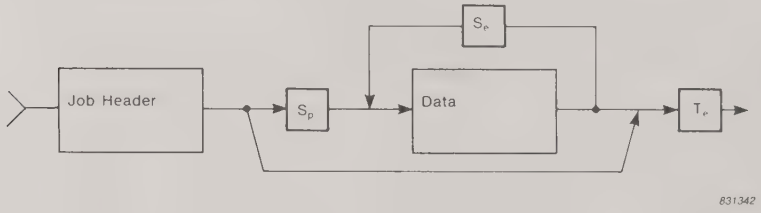



*Fig. 4.2. Job syntax diagram*

The 'Job Header' describes the job to be carried out. The 'Data', if present, is used to further specify the job. To separate the 'Job' from the 'Data', a separator $S_p$ is used.

Data may be formatted by a Separator $S_e$. The job specification ends with a terminator $T_e$. The following separators and terminator are used:

$S_p$ = ⟨Space⟩

$S_e$ = ⟨ , ⟩

$T_e$ = ⟨LF⟩ or ⟨EOI⟩ with any character.

The character to be sent is the character **between** the brackets – not the brackets themselves. Errors in the job specification will cause the 2313 to send an SRQ (Service Request) if the service request function is enabled by the job specification SRQENABLE (see Section 4.3.5), otherwise an error message will be printed and the 2313 will lock up. After pressing 'Reset' to clear the lock up, the service request function will be disabled.

### 4.3.5. Jobs in the BZ 7000

The Job Header consists of one word which may be written in its entirety but may be shortened at least until the underlined part of the word. No data is present in the job specification when using the BZ 7000.

Example: PRINTER ⟨LF⟩ or
PRINT ⟨LF⟩ or
PR ⟨LF⟩

will give the same result.

List of Jobs:

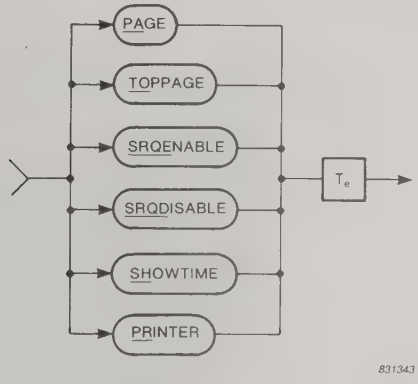



*Fig. 4.3. Syntax diagram showing list of 2313 Jobs*

| | |
|---|---|
| PAGE | The remainder of a page will be fed. |
| TOPPAGE | The current position will be defined as the top of page. |
| SRQENABLE | Enables the 2313 to send out a service request in the case of job specification error, error during the job or lack of paper. Upon errors the 2313 will lock until a serial poll has been carried out. See Section 4.3.6. |
| SRQDISABLE | Disables the 2313 from sending out service request upon errors. Note however, that the 2313 will still lock. See Section 4.3.7 on clearing the 2313. |
| SHOWTIME | Results in a printout of data and time on the paper. |
| PRINTER | Brings the 2313 to work in a printer mode as described in Section 4.4. |
| | While the above jobs terminate themselves, the PRINTER job will run until cleared from the front panel or remotely. |

### 4.3.6. Polling the Status of the 2313

If the service request function is enabled (see Section 4.3.5), an error will cause an SRQ (service request signal). To locate the device asking for service and to get information about the cause of the error, a serial poll can be carried out by the controller.

The status byte read by the controller carries the following information:

bit 7 — 2313 is asking for service
bit 6 — 2313 is in an abnormal condition
bit 5 — 2313 is busy carrying out a job
bit 4 — 2313 is out of paper
bit 1 — 2313 has detected a job specification error

Bit 2, 3 and 8 are not used and set to false (= 0). At the same time as bit 4 is set, the 2313 will print:

Printing not allowed – Do check paper roll ERROR NO.: 0

and as bit 1 is set the 2313 will print:

Job Specification error ERROR NO.: 18

A serial poll will clear this error condition if service request is enabled or else a clearing has to be carried out. See Section 4.3.7.

Another method of polling the 2313 is the Parallel Poll. After the polling sequence is made by the controller, a parallel poll will give the same information as bit 5 in the serial poll status byte.

### 4.3.7. Clearing the 2313 via the Bus

*Device Clear (DCL) or Selected Device Clear (SDC)*

A Reset of the 2313 will be made clearing print buffer and job specification buffer as well as a running job. The interface functions will not be cleared.

*Interface Clear (IFC)*

If the 2313 has been manually brought to the printer mode, the IFC will cause both a Reset as for a DCL and a reset of the interface functions.

If the 2313 previously has been remotely operated then only the interface functions will be reset.

## 4.4. PRINTING WITH THE TYPE 2313/BZ 7000

The following procedure for printing data transferred over the interface bus applies when the 2313 is in its 'printer' (or listen only) mode. This can be achieved manually as outlined in Section 4.3.2 or by addressing the 2313 and sending the job specification PRINTER as described in Section 4.3.5. The 2313 will then be in its 'printer' mode, accepting ASCII characters sent over the interface bus and printing them out on receipt of 〈LF〉 (Line Feed), 〈EOI〉 (End Or Identify), or when the 2313's buffer is full. Characters are stored in sequence in the buffer and are printed out with automatic line feeds inserted in the case of overflow.

By sending the appropriate command, given overleaf, the ASCII printer format can be altered, or the 2313 brought into its graphic mode. The 2313 can be unaddressed to isolate it from interface bus activity, however when re-addressed, the 2313 will remain in its 'printer' mode. Deactivating the 'printer' mode is achieved by sending DEVICE CLEAR or SELECTED DEVICE CLEAR (see Section 4.3.7), or by manually activating any of the Reset levels (see Section 3.4).

| Bit Numbers $b_4$ $b_3$ $b_2$ $b_1$ | $b_8$ $b_7$ $b_6$ $b_5$ 0 0 0 | 0 0 0 1 | 0 0 1 0 | 0 1 1 1 | 0 1 0 0 | 0 1 0 1 | 1 1 0 | 1 1 1 1 |
|---|---|---|---|---|---|---|---|---|
| 0 0 0 0 | NUL | DLE | SP | 0 | @ Δ | P π | ` | p |
| 0 0 0 1 | SOH | DC1 | ! | 1 | A α | Q ∫ | a | q |
| 0 0 1 0 | STX | DC2 | " | 2 | B ² | R æ | b | r |
| 0 0 1 1 | ETX | DC3 | # | 3 | C Σ | S σ | c | s |
| 0 1 0 0 | EOT | DC4 | $ | 4 | D δ | T τ | d | t |
| 0 1 0 1 | ENQ | NAK | % | 5 | E € | U ü | e | u |
| 0 1 1 0 | ACK | SYN | & | 6 | F φ | V √ | f | v |
| 0 1 1 1 | BEL | ETB | ' | 7 | G ω | W _ | g | w |
| 1 0 0 0 | BS | CAN | ( | 8 | H Ω | X ↑ | h | x |
| 1 0 0 1 | HT | EM | ) | 9 | I ⁰ | Y ↓ | i | y |
| 1 0 1 0 | LF | SUB | * | : | J ⁰ | Z → | j | z |
| 1 0 1 1 | VT | ESC | + | ; | K Ø | [ ← | k | { |
| 1 1 0 0 | FF | FS | , | < | L λ | \ – | l | ¦ |
| 1 1 0 1 | CR | GS | - | = | M μ | ] _ | m | } |
| 1 1 1 0 | SO | RS | . | > | N ± | ¯ ¡ | n | ~ |
| 1 1 1 1 | SI | US | / | ? | O ■ | - ¦ | o | DEL |

T00079GB4

*Table 4.2. Table of ASCII (ISO 646 equivalent) characters showing also the special characters available on the 2313*

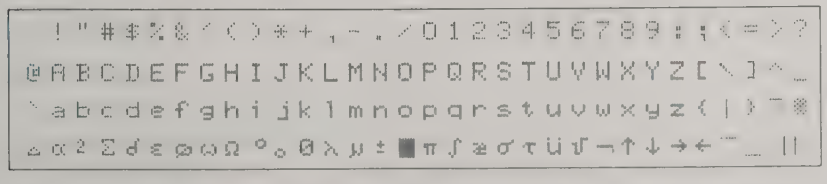


*Fig. 4.4. Sample print out from the 2313 showing the alphanumeric characters available*

The 2313 can print out all the non-control ISO characters as well as a range of special characters after receiving the ISO control character 〈SO〉 (see below), or by using 8 bit characters and setting bit 8 = 1. The range of control characters and their influence on the 2313 when in the 'printer' mode are listed below:

〈LF〉 Produces a line feed i.e. the current line is terminated and a new line started.

〈FF〉 Produces a form feed i.e. the current page is terminated and a new page started.

〈SO〉 The ISO characters between decimal 64 and 95 are replaced by special characters as shown in Table 4.2. This is maintained as long as the 2313 is in the 'printer' mode or until 〈SI〉 is sent.

〈SI〉 Returns the standard ISO character set if previously changed by sending 〈SO〉.

〈ESC〉 Notifies the 2313 of the start of a sequence, terminated by a ':', to change the printer format in 'printer' mode, or to access the graphic mode (see Sections 4.4.1 and 4.4.2).

The use of 〈SO〉, 〈SI〉 and 〈ESC〉 sequences conform to ISO 2022 (Code Extension Techniques).

### 4.4.1. Changing the Print Format in 'Printer' Mode

Each standard character occupies a space of 8 pixels high by 6 pixels wide. The character height, distance between characters, line spacing can be altered as well as adding an underline. Fig. 4.5 gives the syntax of the sequence used to alter the format. The character height is a number between 1 and 4 (default is 2), where 1 is 1/2 of the standard height, 3 is 3/2 times the standard height etc. The space between characters is between 0 and 5 pixels (default is 0). The space between lines is between 0 and 7 pixels (default is 2). The underline feature underlines the following line only and is cancelled on receipt of 〈LF〉.

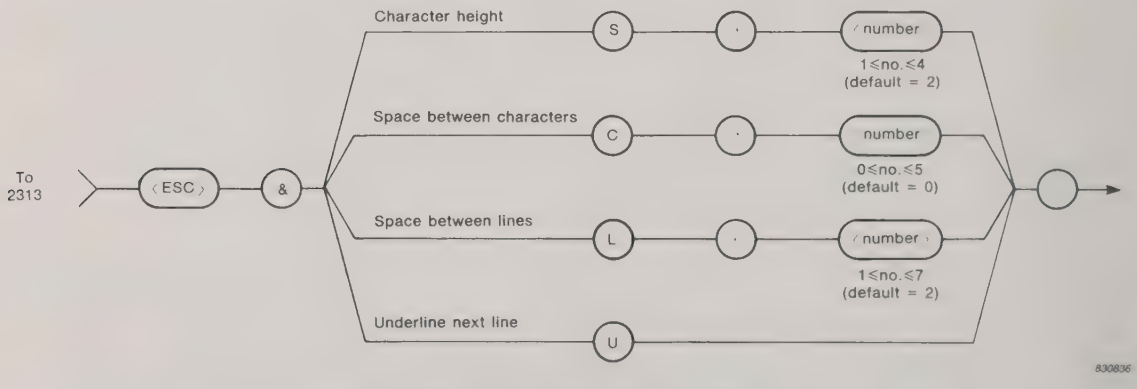



*Fig. 4.5. Syntax diagram for altering the standard character format*

```
This is normal text
written in standard format

This text has minimum character height

This text has maximum character height


This text has minimum character spacing (default)

T h i s  t e x t  h a s  m a x i m u m  c h a r a c t e r  s p a c i n g

These two lines of text
have minimum line spacing

These two lines of text
have maximum line spacing


This text is underlined
```

*Fig. 4.6. Sample print out from the 2313 showing various format possibilities*

### 4.4.2. Changing to the 'Graphic' Mode

In the graphic mode, the binary data sent to the 2313 activate the pixels directly. Fig. 4.8 gives the syntax used when printing in graphic mode. This specifies what binary data follows this ⟨ESC⟩ sequence and it is important that the following data is as specified. On completion of the graphic print-out, the 2313 returns to the normal ASCII mode. At this point and not before, a further ⟨ESC⟩ sequence can be initiated. The number of graphic lines is from 1 to 999 (default of 1). The number of graphic bytes per line is from 1 to 64 (default of 64 which is one complete line). The Graphic line start point is from 1 to 63 (default is 1 i.e. start at first line). Fig. 4.7 gives an example of the construction of one graphic line.

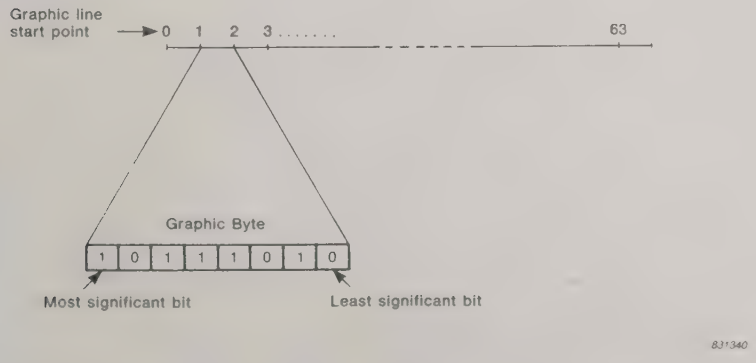



*Fig. 4.7. Example of the construction of one graphic line*

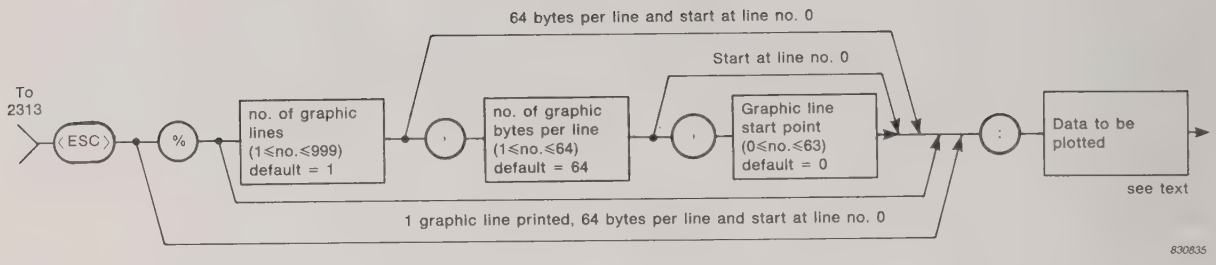

64 bytes per line and start at line no. 0
Start at line no. 0
To 2313
⟨ESC⟩
%
no. of graphic lines (1≤no.≤999) default = 1
,
no. of graphic bytes per line (1≤no.≤64) default = 64
,
Graphic line start point (0≤no.≤63) default = 0
:
Data to be plotted
see text
1 graphic line printed, 64 bytes per line and start at line no. 0
830835

*Fig. 4.8. Syntax diagram for plotting in the graphics mode*

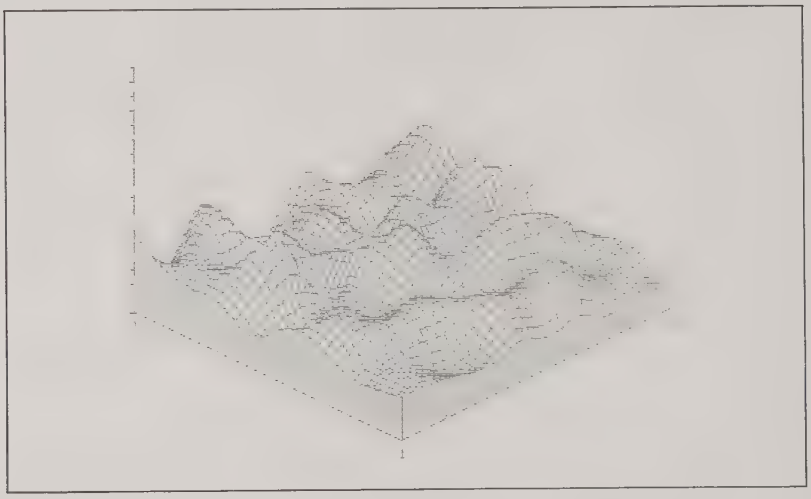
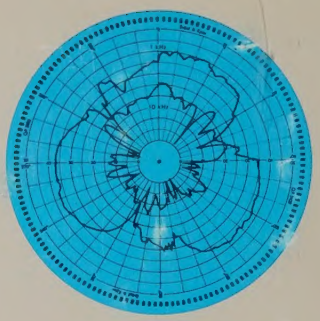
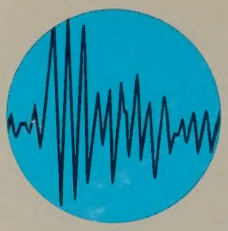


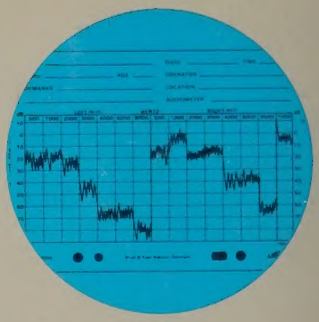
*Fig. 4.9. Example of a plot, produced by the 2313 when in graphics mode*

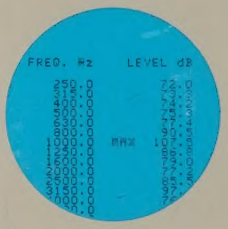
## 5. SERVICE AND REPAIR

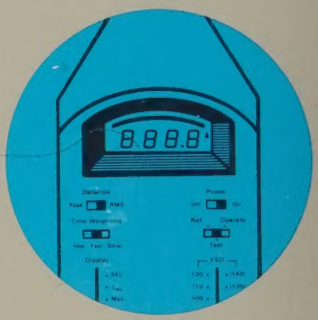
The 2313 is designed and constructed to provide the user with many years of safe, reliable operation. However, should a fault occur which impairs its correct function and possibly operating safety, then it should be immediately disconnected at the mains source and be secured against unintended operation. For repair consult the separate Service Instruction Manual for the instrument or contact your local B & K service representative. Under no circumstances should repair be attempted by persons not qualified in the service of electronic instrumentation.

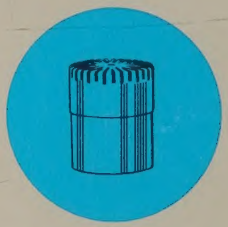


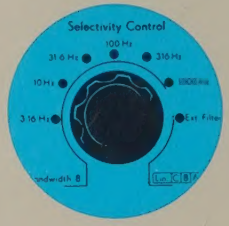


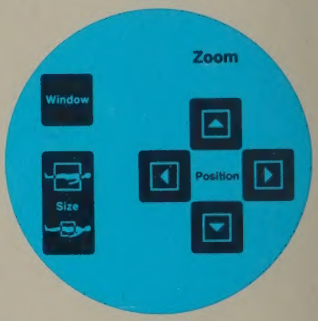


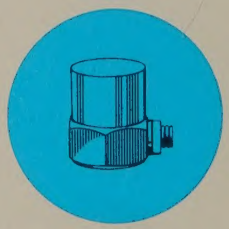


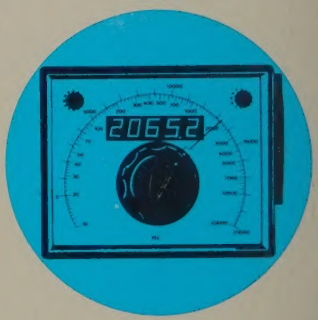



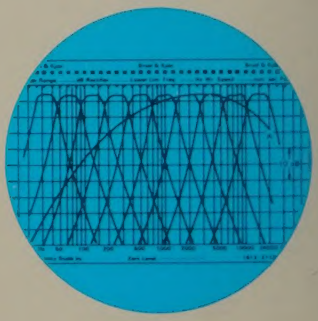











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